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Hominins and Proboscideans in the Lower and Middle Palaeolithic in the Central Iberian Peninsula

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ABSTRACT

Since the middle of the 19th Century, when the first elephant remains were excavated near Madrid (Spain), continuous discoveries of proboscideans have taken place on the riverbanks of the middle and lower courses of the Manzanares and Jarama rivers. The pioneering research carried out by Aguilera y Gamboa in Torralba and Ambrona (Soria, Spain) in the early 20th Century was followed decades later by Howell and others. These various studies have ensured that the Iberian Peninsula is central to the debate over the human exploitation of proboscideans during the Lower and Middle Palaeolithic in Europe. An updated revision of the relationship between hominins and proboscideans in the interior of the Iberian Peninsula, specifically in the area located along the valleys of the Manzanares and Jarama rivers, has been carried out by the authors and is presented in this paper. European sites which show evidence of proboscidean exploitation are substantially greater in number during the Lower Palaeolithic than during the Middle Palaeolithic. In the Manzanares and Jarama valleys, a substantial number of sites with Acheulean lithic industry associated with elephant remains have been recorded, although plenty of evidence dating to the Middle Palaeolithic has also been found. This implies that Mousterian groups made use of these animal resources in a similar way to the Acheulean groups, and that there were no substantial changes to their subsistence strategies in relation to these mammals. Therefore, the exploitation of mega-mammals for food was a recurrent phenomenon during the Acheulean and Middle Palaeolithic in the interior of the Iberian Peninsula.

1. Introduction

The Iberian Peninsula has played a key role within the debate over the hominins exploitation of proboscideans during the Palaeolithic in Europe. Since 1778, when elephant bones began to be unearthed near Madrid (Spain), continuous discoveries of these pachyderms have taken place in the banks of the lower and middle courses of the Manzanares and Jarama valleys. Two accumulations of adult male elephants next to each other -although in a different stratigraphical positions-were excavated in 1847 and 1850 by M. de la Paz Graells (1808–1898) (Aragón and Rábano, 2015). These were found in the T +25–30 m terrace of the river Manzanares, in Cerro de San Isidro, and constitute the first palaeontological excavation carried out in Spain (Fig. 1) (Graells de la Paz, 1897). Within these same levels, in 1862, the Spanish geologist C. del Prado (1797–1868), together with E. de Verneuil (1805–1873) and L. Lartet (1840–1899) recognised the first lithic tools identified in the Iberian Peninsula, establishing the starting point of the Prehistory in Spain (Santonja and Vega, 2002; Pelayo and Gozalo, 2013). In addition, Spain was one of the first countries where lithic industry was recorded in association with extinct fauna, as it occurs in the sites of the Somme Valley (Boucher de Perthes, 1849) and Brixham cave (Gruber, 1965).

A few decades later, E. de Aguilera y Gamboa (1845–1922) excavated at Torralba between 1909 and 1913, as well as at Ambrona, 2.5 km to the north, between 1914 and 1916, (Aguilera-Gamboa, 1913). Both sites are located in a strategic position within a transit area where natural routes connect the three main drainage basins in the interior of the Iberian Peninsula, the Ebro, Duero and Tagus rivers. These works were highly significant in Europe, and were visited by the most outstanding researchers at the time. Between 1961 and 1963, C. Howell together with K.W.

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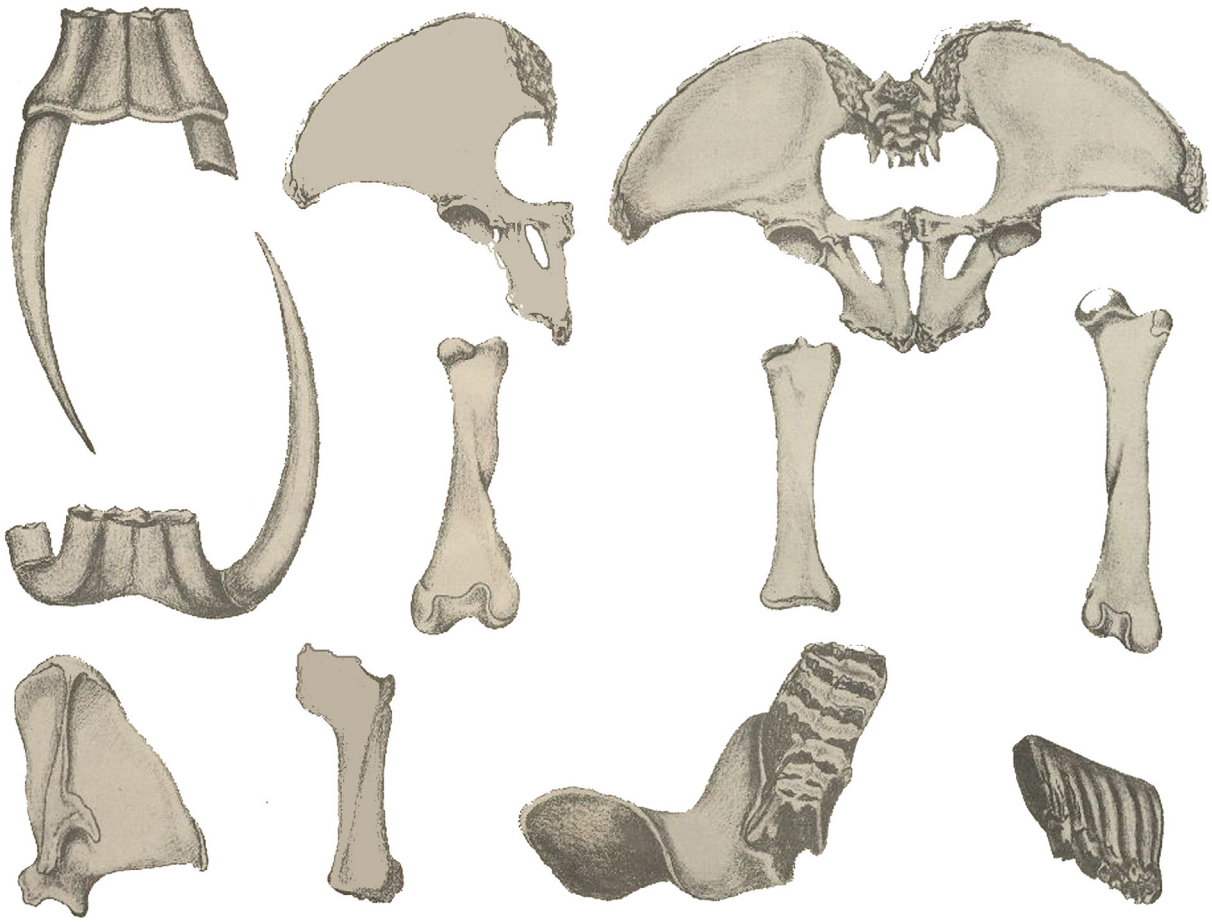

Fig. 1. Depiction of proboscidean remains from Tejar de las Ánimas displayed in Graells' print XXII (1897).

Butzer, E. Aguirre, P. Biberson and L. G. Freeman excavated 1026 m^2 in Torralba and 1243 m^2 in Ambrona, reaching similar conclusions to those of Aguilera-Gamboa (1913). Hominins would have used fire to herd the elephants towards swampy areas (Freeman and Butzer, 1966; Howell, 1966; Freeman and Howell, 1981, 1982; Howell and Freeman, 1982, 1983). A similar interpretation was also suggested for African sites, such as BK in Bed II of the Olduvai Gorge–Tanzania- (Leakey, 1954).

This model was criticized by Binford (1987), based on the fact that the deep impact of the elephants and other natural agents on the ground could not allow an accurate interpretation. Between 1980 and 1983 Howell and Freeman carried out a new research phase in Ambrona, digging a further 1267 m^2 2717 m^2 had been excavated by 1983 (Howell, 1965; Howell et al., 1995). They reached similar conclusions to those of the earlier phase, adding this time that parts of the killed animals had been transported to the base camps (Freeman, 1994).

In the absence of published information, a new project directed by M. Santonja and A. Pérez-González was carried out between 1990 and 2000. The excavation of 688 m^2 in the Lower Stratigraphic Member of Ambrona (Santonja and Pérez-González, 2005; Santonja et al., 2017), has secured a precise chronology of these sites: MIS 11-10/9 for Ambrona and MIS 7 for Torralba (Parés et al., 2005; Falguères et al., 2006; Santonja et al., 2014; Blain et al., 2015). It also established that elephant and other animal bone accumulations were due to natural causes, and that only a few remains show evidence of human manipulation (Santonja and Pérez-González, 2005).

In the Manzanares valley, Hugo Obermaier's initiative (1879–1946), and under his supervision J. Pérez de Barradas (1897–1980) and P. Wernert (1889–1972), carried out intense research on the Manzanares fluvial sand quarries located closest to Madrid between 1917 and 1931. They recorded several assemblages of lithic industry and fauna, including proboscideans. The tumultuous decade of the 1930s and the Civil War cut short these works, which were not resumed until the 1950s. This coincided with the 4th International Congress of Prehistoric Science and the 5th Quaternary Congress (INQUA), which were held in Madrid in 1954 and 1957 respectively. In 1957, remains of two *E. (Paleoloxodon) antiquus,* possibly associated with lithic industry, were excavated at the site of TRANSFESA, on the T +25–30 m of the river Manzanares (Meléndez and Aguirre, 1958). In 1959, the skull and two tusks of an *E. (Paleoloxodon) antiquus* were found in the same fluvial terrace, at the site of Orcasitas. Acheulean lithic industry was also found at this site, although it is unknown whether this was related to the proboscidean bones (Quero-Crespo, 1994).

It is only since 1976 that proboscidean remains have been excavated with modern methodology in Spain. This occurred at the sites of Áridos 1 and Áridos 2, located on the Complex Terrace of Arganda in the Jarama valley, where remains were found associated with Acheulean lithic industry. These works were carried out by a multidisciplinary team coordinated by M. Santonja, A. Pérez-González and N. López, whose publication (Santonja et al., 1980) is still a core reference in any synthesis about the Palaeolithic. Innovations brought by this research were not merely methodological; social and economic interpretations about the sites with

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regard to the development of hominin activities were introduced.

The main evidence of proboscidean bone remains associated with lower and middle Palaeolithic lithic industries from the Manzanares and Jarama valleys are shown below. The analysis which was carried out over 60 sites, together with the new discoveries that have taken place recently, allow new hypotheses related to the exploitation of proboscidean by hominins groups between the end of the Middle Pleistocene and Early Late Pleistocene to be considered (Panera et al., 2015; Rubio-Jara et al., 2016).

2. Materials and methods

2.1. Materials

Faunal assemblages from archaeological excavations carried out in the Manzanares and Jarama valleys before 1970 were traditionally not studied taphonomically. Therefore, in this paper we present the taphonomic analysis carried out on 60 sites with proboscidean remains and lithic industry, located in the valleys of the Manzanares and Jarama rivers, which were stored in several museums in Madrid: San Isidro, Museo Arqueológico Nacional and Museo Arqueológico Regional of Comunidad de Madrid. These 60 sites are shown in Table 1. Nine of these were totally unpublished whereas seven have been published recently (Yravedra, 2010; Yravedra et al., 2010, 2012, 2014; Panera et al., 2015).

The main characteristics of the analysed bone samples can be observed in Table 1, and the geographical location of the most significant samples is shown in Fig. 2.

2.2. Methods

To understand the relationship between proboscidean remains and lithic industries recorded at sites where both types of remains have been found, the bones of these mega-herbivores have been taphonomically analysed, in order to record any evidence of human exploitation.

A number of studies indicate that cut marks are rarely produced when defleshing or disarticulating elephants (Crader, 1983; Haynes and Krasinski, 2010), so an elephant can be processed without leaving marks on the bones. This is due to the thickness of the periosteum and other tissues (Biberson and Aguirre, 1965; Haynes, 1991; Haynes and Krasinski, 2010), which hinders contact between the lithic tool and the bone while bulk defleshing (Villa, 1990; Musi, 2005; Villa et al., 2005; Musi and Villa, 2008). On many occasions, this makes it almost impossible to discern whether mammals weighing over one ton were processed by human beings. Traditionally, it has been interpreted that associations between lithic industry and elephant remains were symptomatic of human activity (Leakey, 1971; Patrocinio et al., 2013). However, these accumulations can also be caused by circumstantial events, and taphonomic studies are necessary to reveal to what extent these sites are the result of human activity (Martos, 1998; Domínguez Rodrigo, 2008; Yravedra et al., 2014). Only the presence of marks on the bones, such as cut or percussion marks, can identify direct human processes on proboscidean remains. Therefore the correct recording of these marks is extremely important.

We have followed the methodology described in Blumenschine (1995) and Yravedra et al. (2010, 2012, 2014), where the bones were screened with hand lenses using a magnification of 10X, 15X and 20X. Bone surfaces were then directly analysed for cut and percussion marks with an optical microscopy of 20–40X in the Department of Prehistory, Complutense University of Madrid. The images were transmitted directly to a computer and processed with Motic Image Plus 2.0 Software.

The identification of cut marks was based on Binford (1981), Shipman (1981) and Bunn (1982). Trampling and cut marks were distinguished according to Olsen and Shipman (1988) and Domínguez-Rodrigo et al. (2009). Thus, cut marks tend to be straight, V section, greater in depth than in width, with variable length and orientation. They can be found either isolated or associated with other marks; often they show microstriations and can be occasionally associated with barbs (Shipman, 1981) or shoulder effects (Martin, 1907; Shipman and Rose, 1983). On the contrary, trampling marks are superficial, wide and shallow, with a U-shaped section and flat base, and are without microstriations. Teeth and percussion marks were established according to Blumenschine (1988, 1995), Blumenschine and Selvaggio (1988), Pickering and Egeland (2006) and Galán et al. (2009), and include several types of tooth marks, such as scores, pits and punctures. Apart from tooth marks, other alterations generated by carnivores such as furrowing have been observed.

The impact of water activity was assessed by the presence of abrasion, polishing, rounded bones and carbonates (Voorhies, 1969). Signs of polishing, rounding or abrasion would be expected in transported assemblages, but also in non-transported assemblages exposed to circulating water and mobile sediments, such as those encased in sand strata (Thompson et al., 2011). Determining whether or not the assemblage is in primary versus secondary position is particularly important given the fluvial depositional context of the sites.

2.3. Geological framework

The study area comprises the fluvial valleys of the Manzanares and Jarama rivers of Madrid. These are located within the River Tagus basin, which runs through the South Sub-Meseta of the Iberian Peninsula. It is bordered by the Sistema Central (Gredos and Guadarrama mountains) to the north. Both valleys lie within a continental Tertiary basin (the Madrid Basin), in the transitional area between the intermediate detritic facies (gravels and sands) and the central facies (marls to evaporite-gypsum) (Pérez-González, 1971), which were representative of areas with a high hydric availability during the Pleistocene. This geomorphological framework favoured the gathering of fauna around the fluvial corridors, but also the processes of fluvial sedimentation and preservation of archaeo-paleontological remains. The highest concentration of palaeolithical sites known in the Iberian Peninsula is found within the deposits of the middle and lower terraces of the last stretch of the Manzanares river, which runs along a 22 km valley from the site of San Isidro, right in the centre of Madrid, to its confluence with the Jarama, as well as in the middle stretch of the Jarama river (Figs. 2 and 3).

Distribution of numerical data is limited and very heterogeneous, as only recently found sites have been studied systematically. Generally, the fluvial terraces within the study area range from the Middle to the end of the Late Pleistocene (Pérez-González, 1971; Uribelarrea, 2008; Panera et al., 2011; Rubio-Jara et al., 2016). Some sites, such as PRERESA at Manzanares and Valdocarros II at Jarama, have been dated more accurately through amino acid racemization and OSL (Table 1).

The stretch of the Manzanares river which has been studied runs along 22 km from the city of Madrid until its confluence with the river Jarama. In the Manzanares valley, from a geological and geomorphological point of view, there are two well differentiated sections. Upstream from Madrid, 13 terrace levels have been recorded between +4 and 5 m and 95 m (Pérez-González and Uribelarrea del Val, 2002). Downstream, the terraces formed over evaporitic rocks +25–30 m, and +18–20 m, are overlapped and affected by the synsedimentary subsidence resulting in a huge thickness increase of tens of meters (Pérez-González, 1971;

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Table 1
Sites with proboscidean remains in the Manzanares and Jarama valleys in Madrid. Biochronological column: MP Middle Pleistocene; LP Late Pleistocene; Anthropogenic alterations column: CM Cut Marks; PM Percussion Marks. * Sites with taphonomic revision carried out for this paper.

Site	Biochronology	Presence/Absence of Lithic Tools	Characteristic proboscidean				Other relevant mammal faunas (*Animals with anthropogenic marks)	Other relevant taphonomicalterations	References
			Proboscidean species	Anthropogenic alterations	NISP	MNI			
Áridos 1	MIS 11 MP	328 pieces: 27 quartzite, 300 flint, 1 quartz; 4 pebbles, 62 flakes, 10 levallois flakes, 8 cores, 2 handaxe points, 4 chopping tools, 238 shatter.	*E. (Paleoloxodon) antiquus*		2	1	Canidae indet, *Cervus elaphus*, Cervidae sp., *Bos/Bison*, *Sus* sp., *Hippopotamus; Castor fiber**		Santonja et al., 1980; Villa, 1990; Yravedra et al., 2010
Áridos 2	MIS 11 MP	34 pieces: 4 quartzite, 30 flint; 12 flakes, 4 cores, 1 handaxe, 1 cleaver, 26 shatter	*E. (Paleoloxodon) antiquus*	CM	43	1		Hyena tooth mark	Santonja et al., 1980; Villa, 1990; Yravedra et al., 2010
PRERESA	MIS 5/Early MIS 6; LP/MP	754 pieces: 748 flint, 6 quartz (1 pebble and 5 shatter). Complete *Châines operatoires*, cores exhaustively exploited, lack of macrotools, scarce retouched flakes: denticulates and compound tools.	Proboscidea indet.	CM, PM	82	1	*Bos primigenius**, *Capreolus capreolus*, *Haploidocerus mediterraneus*, *Equus* sp., *Meles meles,*	No carnivore intervention	Rubio-Jara 2011; Yravedra et al., 2012; Moreno et al., in press
EDAR Culebro 1	MIS 5 LP	243 pieces. Flint generally, lack of large tools, more than 50% debris, 5% retouched flakes, 5% cores (discoid, bifacial and multifacial schemes)	*Mammuthus* cf. *intermedius*	Green Fracture	35	1	*Equus* sp., Cervidae indet.,	Abrasion Polishing	Yravedra et al., 2014
Requeta Culebro	MIS 5 LP	No Lithics					*Stephanorhinus hemitoechus*, *Equus ferus*, *Canis lupus*, *Cervus elaphus*	Badly preserved bone surface	Unpublished
Estanque de Tormentas de Butarque	MP	2302 pieces. 1539 pieces partially published. 1530 on flint, 9 quartzite; 22 pebbles, 323 flakes, 30 retouched tools, 26 cores, 3 handaxes, 1 bifacial tool, 1 chopping tool, 1133 shatter.	*E. (Paleoloxodon) antiquus*		1	1	*Stephanorhinus hemitoechus*, *Equus ferus*, *Equus* cf. *hydruntinus*, *Cervus elaphus**, *Sus scrofa*, *Bos Primigenius**, *Bison* sp.*	Small carnivore tooth mark	De los Arcos et al., 2008; Laplana et al., 2015
Tafesa	MIS 11–12 MP	651 pieces in four levels. 463 pieces level IV: 448 flint, 10 quartzite, 5 quartz; 167 pebbles, 116 flakes, 85 retouched tools, 21 cores, 22 handaxes, 22 trihedral picks, 2 cleavers, 28 shatter.	*E. (Paleoloxodon) antiquus*		22	2	*Bos primigenius**, *Cervus elaphus**	Small carnivore tooth mark, Trampling, abrasión, Rounding	Silva et al., 2012; Mazo, 2010; Yravedra, 2010; Baena et al., 2010
Transfesa*	MIS11-12 MP	252 pieces	*E. (Paleoloxodon) antiquus*		¿?	1	*Equus ferus*, *Bos/Bison*, *Cervus elaphus*, *Praemegaceros*, *Sus scrofa*	Abrasion, Polishing	Sesé and Soto 2002a, b
Arriaga	MIS 6-5 MP and LP	3088 Pieces	*E. (Paleoloxodon) antiquus*	CM?	95	2	*Stephanorhinus hemitoechus*, *Equus ferus*, *Equus* cf. *hydruntinus*, *Dama* sp., *Cervus elaphus*, *Bos primigenius*, *Bos/Bison**	Abrasion, Polishing, Badly preserved bone surface	Rus and Vega 1984; Cacho and Martos 2002; Gamazo, 2002; Panera et al., 2015
San Isidro*	MP	>6005 pieces. 191 handaxes published	*E. (Paleoloxodon) antiquus*		X	X	*Equus ferus*, *Equus* cf, *hydruntinus*, *Bos/Bison*, *Cervus elaphus*	Abrasion, Polishing, Badly preserved bone surface	Aguirre, 2002; Cacho and Martos, 2002; Gamazo, 2002; Blasco and Carrión, 2002; Sesé and Soto, 2002a, b; Santonja, 1977

Las Mercedes*	MP	>216 pieces	*E. (Paleoloxodon) antiquus*	X	X	*Stephanorhinus hemitoechus*, *Bos/Bison*	Abrasion, Polishing, Badly preserved bone surface	Aguirre, 2002; Blasco and Carrión, 2002; Gamazo, 2002; Sesé and Soto, 2002a, b
Orcasitas*	MP	28 pieces: 2 cores, 12 flakes, 6 retouched tools, 3 handaxes, 1 cleaver, 1 chopping tool, 3 shatter	*E. (Paleoloxodon) antiquus*	7	1	*Equus ferus**, *Cervus elaphus*, *Dama* sp, *Bos primigenius*	polishing	Sesé and Soto 2002a, b; Quero-Crespo, 2002
Arenero Pedro Jaro*	MP	187 pieces	*E. (Paleoloxodon) antiquus*	8	1	Rhinocerotidae, *Equus ferus*, *Haploidoceros mediterraneus*, *Bos/Bison*, *Stephanorhinus hemitoechus**	Polishing Abrasion Small carnivore tooth marks	Gamazo 1982, 2002; Priego et al., 1979; Sesé and Soto 2002a, b
Km 9 Ctra. de Andalucía*	MP	2 pieces	*E. (Paleoloxodon) antiquus*	49	1	*Cervus elaphus*	No carnivore modification	Blasco and Carrión, 2002; Sesé and Soto, 2002a, b
Km 7 Ctra. Andalucía*	MP	349 pieces	*E. (Paleoloxodon) antiquus*	X	X	*Bos/Bison*	No carnivore modification	Blasco and Carrión, 2002; Gamazo, 2002; Sesé and Soto, 2002a, b
Talleres Renfe*	MP	30 pieces	*E. (Paleoloxodon) antiquus*	X	X	*Bos primigenius*, *Equus ferus*, *Dama* sp		Gamazo, 2002; Sesé and Soto, 2002a, b
Arenero Los Llanos*	MP	1429 pieces	*E. (Paleoloxodon) antiquus*	2	1	*Equus ferus*, Cervidae indet, *Bos primigenius*		Gamazo, 1982, 2002; Priego et al., 1979; Sesé and Soto, 2002a, b
Arenero Santa Elena*	MP	4921 pieces	*E. (Paleoloxodon) antiquus; Mammuthus* sp.	5	1	Rhinocerotidae indet., *Equus ferus*, Cervidae indet, *Bos/Bison**, *Megaloceros*	Small presence of water alterations	Gamazo, 1982; Santonja and Querol, 1980; Gamazo, 2002; Cacho and Martos, 2002; Sesé and Soto, 2002a, b
Arenero de Oxígeno*	MP	10416 pieces; published: 219 handaxes, 38 trihedral picks, 21 cleavers	*E. (Paleoloxodon) antiquus*	8	1	*Equus ferus*, Cervidae indet., *Bos/Bison*, *Stephanorhinus hemitoechus*, *Equus* cf. *hydruntinus*, *Bison* sp., *Cervus elaphus*	Polishing Abrasion Rounding	Sesé and Soto, 2002a, b; Gamazo, 1982, 2002; Cacho and Martos, 2002
Arenero del Quemadero*	MP	3809 pieces	*E. (Paleoloxodon) antiquus*	X	X	*Equus ferus*, *Equus* cf. *hydruntinus*, *Bos/Bison*		Gamazo, 1982, 2002; Sesé and Soto, 2002a, b
Arenero Manuel Soto*	MP	Several pieces	*E. (Paleoloxodon) antiquus*	X	X	Rhinocerotidae, *Equus ferus*, *Cervus* sp, *Dama* sp., *Bos/Bison*, Carnivore indet.		Gamazo, 1982; Priego et al., 1979; Gamazo and Cobo, 1983; Sesé and Soto, 2002a, b
Arenero de Jesús Fernández*	Indet	1555 pieces	Proboscidea indet.	X	X	*Cervus elaphus*, *Bos primigenius*		Priego et al., 1979; Gamazo, 1982, 2002; Sesé and Soto, 2002a, b
Arenero de Constantino del Río*	Indet	2731 pieces	Proboscidea indet.	X	X	*Equus ferus*, *Sus scrofa*		Gamazo, 1982, 2002; Sesé and Soto, 2002a, b
Arenero la Torrecilla*	LP	1748 pieces	Proboscidea indet.	X	X	Cervidae indet.		Gamazo, 1982, 2002; Cacho and Martos, 2002; Gamazo and Cobo, 1983; Sesé and Soto, 2002a, b
Arenero Los Pinos*	MP	5868 pieces	Proboscidea indet.	2	1	Rhinocerotidae indet., *Equus ferus*, *Equus* cf. *hydruntinus*, *Cervus elaphus*, *Bos/Bison*	No carnivore modification	Priego et al., 1979; Gamazo, 1982, 2002; Cacho and Martos, 2002; Sesé and Soto, 2002a, b

(*continued on next page*)

Table 1 (*continued*)

Site	Biochronology	Presence/Absence of Lithic Tools	Characteristic proboscidean				Other relevant mammal faunas (*Animals with anthropogenic marks)	Other relevant taphonomicalterations	References
			Proboscidean species	Anthropogenic alterations	NISP	MNI			
Arroyo Culebro*	MP and LP	863 pieces	*E. (Paleoloxodon) antiquus*and *Mammuthus* cf. *primigenius*		X	X	Rhinocerotidae indet., *Coelodonta antiquitatis*, *Equus ferus*, *Cervus elaphus*, *Bison priscus*, *Megaloceros* sp.	Hyena tooth mark, Polishing	Gamazo, 1982, 2002; Cobo et al., 1979; Sesé and Soto, 2002a, b
Ramón Soto*	MP	1318 pieces	*E. (Paleoloxodon) antiquus*and *Mammuthus* sp.		X	X	*Equus ferus*		Gamazo, 1982, 2002; Cobo et al., 1979; Gamazo and Cobo, 1983; Sesé and Soto, 2002a, b
Arenero Rojas*	MP	1424 pieces	*E. (Paleoloxodon) antiquus* and *Mammuthus* cf. *intermedius*		X	X	*Equus ferus*, *Equus* cf. *hydruntinus*, *Bos/Bison*		Gamazo, 1982, 2002; Sesé and Soto, 2002a, b
Fábrica de Ladrillos *	MP	1074 Pieces	*E. (Paleoloxodon) antiquus*and *Mammuthus* cf. *intermedius*		X	X	*Stephanorhinus hemitoechus*, *Equus ferus*, *Cervus elaphus*, *Bos primigenius*	Abrasion, Polishing	Gamazo, 1982, 2002; Sesé and Soto, 2002a, b
Arenero Arcaraz*	MP and LP	1424 Pieces	*E. (Paleoloxodon) antiquus*and *Mammuthus* cf. *intermedius*, *Mammuthus trogontherii*		X	X	*Megaceros* cf. *giganteus*, *Equus ferus*, *Bos primigenius*, *Coelodonta antiquitatis*		Gamazo, 1982; Cobo et al., 1979; Sesé and Soto, 2002a, b
Arenero de Casa Eulogio*	MP and LP	228 Pieces	Proboscidea indet., *Mammuthus trogontherii* and *Mammuthus* cf. *primigenius*		X	X	*Equus* sp., Cervidae indet, *Bos primigenius*, *Equus ferus*, *Cervus elaphus*,	No carnivore modification, Abrasion	Gamazo, 1982, 2002; Cobo et al., 1979; Sesé and Soto, 2002a, b
Arenero Vaciamadrid*	MP	260 + 49 pieces, uncertain provenance	*E. (Paleoloxodon) antiquus*		X	X	*Equus ferus*, *Stephanorhinus hemitoechus*, *Bison* sp, *Bos/Bison*,		Gamazo, 2002; Sesé and Soto, 2002a, b
Valdocarros*	MP	Several Pieces.	Proboscidea indet.		4	1		No important carnivore activity	Panera et al., 2011; Sesé and Soto, 2002a, b;
Arenero Carolinas*	MP	>128 pieces	Proboscidea indet.		X	X	*Equus ferus*, *Bos/Bison*	Abrasion, Polishing	Aguirre, 2002; Cacho and Martos, 2002; Gamazo, 2002; Sesé and Soto, 2002a, b
Arenero Mayoral*	MP	1090 pieces	Proboscidea indet.		X	X	*Bos/Bison*, *Cervus elaphus*, *Canis* sp.	Abrasion, Polishing	Gamazo, 2002; Sesé and Soto, 2002a, b
Mejorada del Campo*	MP	111 pieces	Proboscidea indet., *E. (Paleoloxodon) antiquus*		1	1			Gamazo, 2002; Sesé and Soto, 2002a, b
Arenero Nicasio Poyato*	MP and LP	519 pieces	Proboscidea indet.		X	X	*Equus* sp., *Cervus elaphus*, Carnivore indet	Abrasion, Polishing	Blasco and Carrión, 2002; Gamazo, 2002; Sesé and Soto, 2002a, b
Parador del Sol*	MP	>3692 pieces	Proboscidea indet.		X	X	*Equus* sp., *Bos primigenius*, *Cervus elaphus.*		Aguirre 2002; Cacho, and Martos, 2002; Gamazo, 2002; Sesé and Soto, 2002a, b
Arenero Tuerto*	MP		Proboscidea indet.		X	X			Sesé and Soto, 2002a, b
Gravera Vicente Fayo*	MP	165 pieces	Proboscidea indet.		X	X		Abrasion, Polishing	Gamazo, 2002; Sesé and Soto, 2002a, b

Arenero de Aguado Manzanares*	MP	1970 pieces	*E. (Paleoloxodon) antiquus*	X	X	*Equus* sp.		Gamazo, 2002; Sesé and Soto, 2002a, b
Arenero de Aguado Jarama*	MP	1 piece	*E. (Paleoloxodon) antiquus*	X	X	*Bos/Bison*		Gamazo, 2002; Sesé and Soto, 2002a, b
Aniceto Juárez*	MP		*Mammuthus* sp., *E. (Paleoloxodon) antiquus*	X	X			Sesé and Soto, 2002a, b
Aldehuela*	MP and LP	1424 pieces	*E. (Paleoloxodon) antiquus*and *Mammuthus* cf. *Intermedius*	X	X	*Equus ferus**, *Equus* cf. *hydruntinus*, *Bos/Bison*	Abrasion, Polishing	Gamazo, 2002; Sesé and Soto, 2002a, b
Cantera Julio Ordoñez*	MP	10 pieces	*E. (Paleoloxodon) antiquus*	X	X			Gamazo, 2002; Sesé and Soto, 2002a, b
Ciempozuelos*	MP and LP		*E. (Paleoloxodon) antiquus*	X	X			Sesé and Soto, 2002a, b
Arenero Hermanos Muñoz*	MP	1637 pieces	*E. (Paleoloxodon) antiquus*	x	x	Rhinocerotidae indet., *Equus ferus*, *Equus* cf. *hydruntinus*, *Bos/Bison*	Abrasion, Polishing	Gamazo, 2002; Sesé and Soto, 2002a, b
Arenero Juan Pablo*	MP	538 pieces	*E. (Paleoloxodon) antiquus*	1	1	*Equus ferus*, *Stephanorhinus hemitoechus*, *Bos-Bison*		Gamazo, 2002; Cacho and Martos, 2002; Sesé and Soto, 2002a, b
Compuerta*	MP	No Lithics	*E. (Paleoloxodon) antiquus*	X	X	*Bison* sp.		Unpublished
Puñalada*	MP	3584 pieces	*E. (Paleoloxodon) antiquus*	2	1	*Equus ferus*, *Bos primigenius*, *Sus scropha*	No carnivore activity	Gamazo, 2002
Arenero de Emilio Muñoz*	MP	2 pieces uncertain provenance	*E. (Paleoloxodon) antiquus*	13	1	*Stephanorhinus hemitoechus*, *Equus ferus*	No carnivore activity	Cacho and Martos, 2002
Arganda*	MP	109 pieces	*E. (Paleoloxodon) antiquus*	23	1	*Bos/Bison*	No carnivore activity	Cacho and Martos, 2002; Gamazo, 2002;
Arenero Juan Caballero*	MP		*E. (Paleoloxodon) antiquus*	7	1		No carnivore activity	Unpublished
Arenero Viuda Martínez*	MP	186 pieces	*E. (Paleoloxodon) antiquus*	3	1	*Stephanorhinus hemitoechus*, *Equus ferus*, *Bos primigenius*, *Cervus elaphus*	No carnivore activity	Unpublished
Mochuelo*	MP	No Lithics	*E. (Paleoloxodon) antiquus*	2	1		No carnivore activity	Unpublished
Luis de Prado*	MP		*E. (Paleoloxodon) antiquus*	x	x	*Equus ferus*, *Equus* cf. *hydruntinus*, *Sus scrofa*	No carnivore activity	Unpublished
Luis de Pedro Mejorada*	MP		*E. (Paleoloxodon) antiquus*	12	1	*Equus ferus*, *Equus* cf. *hydruntinus*, *Bos primigenius*, *Cervus elapus*, *Capreolus capreolus*, Cervidae indet.	No carnivore activity	Unpublished
Pegaso*	MP	No Lithics	*E. (Paleoloxodon) antiquus*	1	1	*Stephanorhinus hemitoechus*	No carnivore activity	Unpublished
Camino San Martín*	MP	10 pieces uncertain provenance	*E. (Paleoloxodon) antiquus*	X	X	*Bos/Bison*	No carnivore activity	Unpublished
Extremeños*	MP	26 pieces	*E. (Paleoloxodon) antiquus*	1	1	*Stephanorhinus hemitoechus*, *Equus ferus*, *Bos/Bison*	No carnivore activity	Cacho and Martos, 2002

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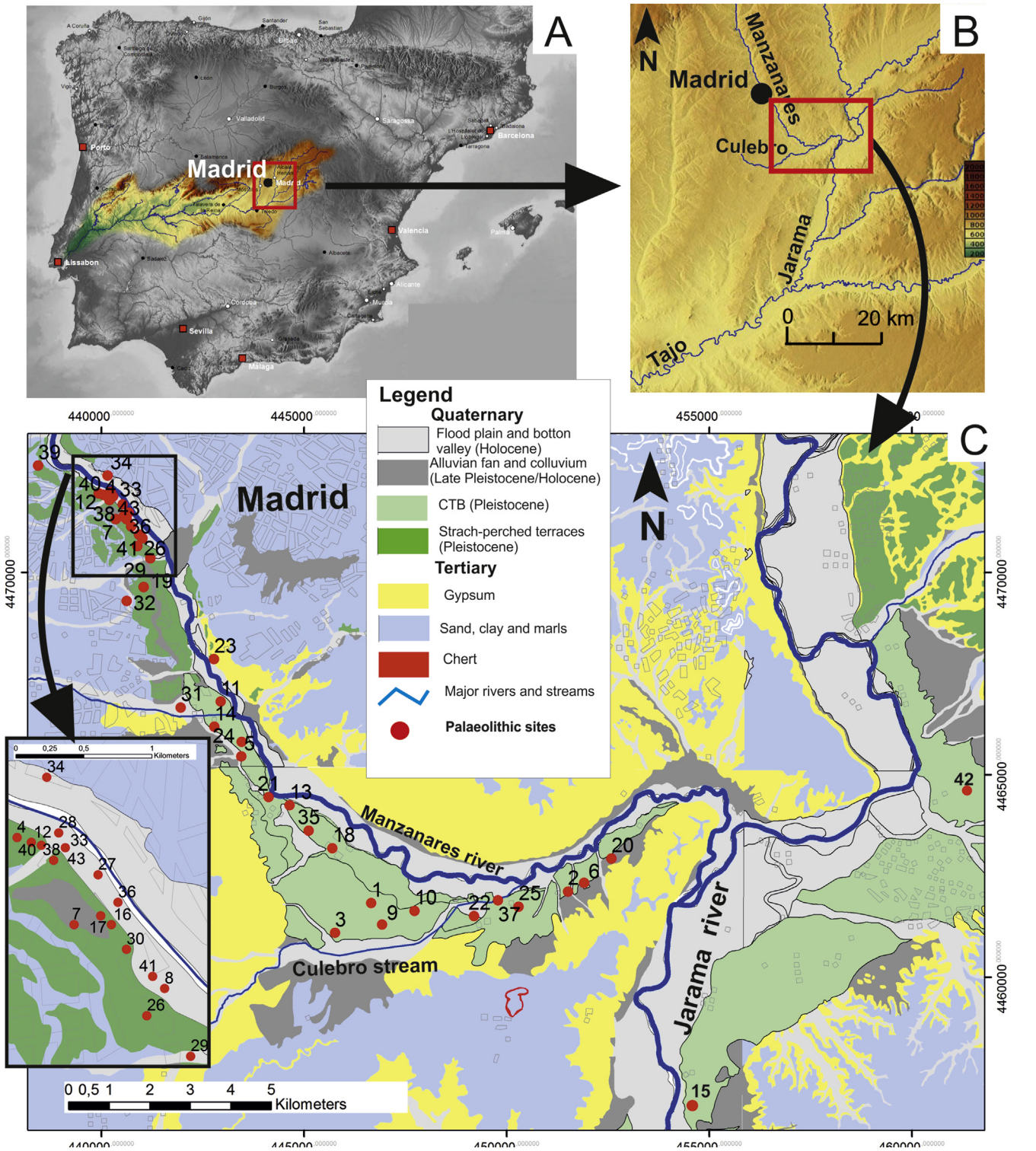

Fig. 2. Geographical location of the Palaeolithic sites located in the Jarama and Manzanares valleys. Names of sites: 1 Arenero de Adrián Rosa; 2 Arenero de Arriaga; 3 Arenero de Arroyo Culebro; 4 Arenero de Domingo Martínez; 5 Arenero de Hermanos Muñoz; 6 Arenero de Navarro; 7 Arenero de Plaza Bonifa; 8 Arenero de Portazgo; 9 Arenero de Ramón Soto; 10 Arenero de Rojas; 11 Arenero de Soto; 12 Arenero Domingo Portero; 13 Arenero Los Pinos; 14 Arenero Santa Elena; 15 Áridos 1 y 2; 16 Atajillo; 17 Atajillo del Sastre; 18 Camino del Espinillo; 19 Casa del Moreno; 20 Casa Eulogio; 21 Constantino del Río; 22 EDAR Culebro; 23 El Almendro yacimiento; 24 Estanque Tormentas Butarque; 25 Fabrica ladrillos; 26 Fuente de la Bruja; 27 Huerto de D. Andrés; 28 La Parra; 29 Las Carolinas; 30 López Cañamero; 31 Los Rosales; 32 Orcasitas (arenero y yacimiento); 33 Parador del Sol; 34 Paseo Yeserías/Matadero; 35 Perales del Río; 36 Prado de los Laneros; 37 PRERESA; 38 Puerta y San Antonio; 39 San Isidro/Tejar Animas; 40 Tejar de D. Joaquín; 41 Tejar de Portazgo; 42 Valdocarros; 43 Vaquerías del Torero.

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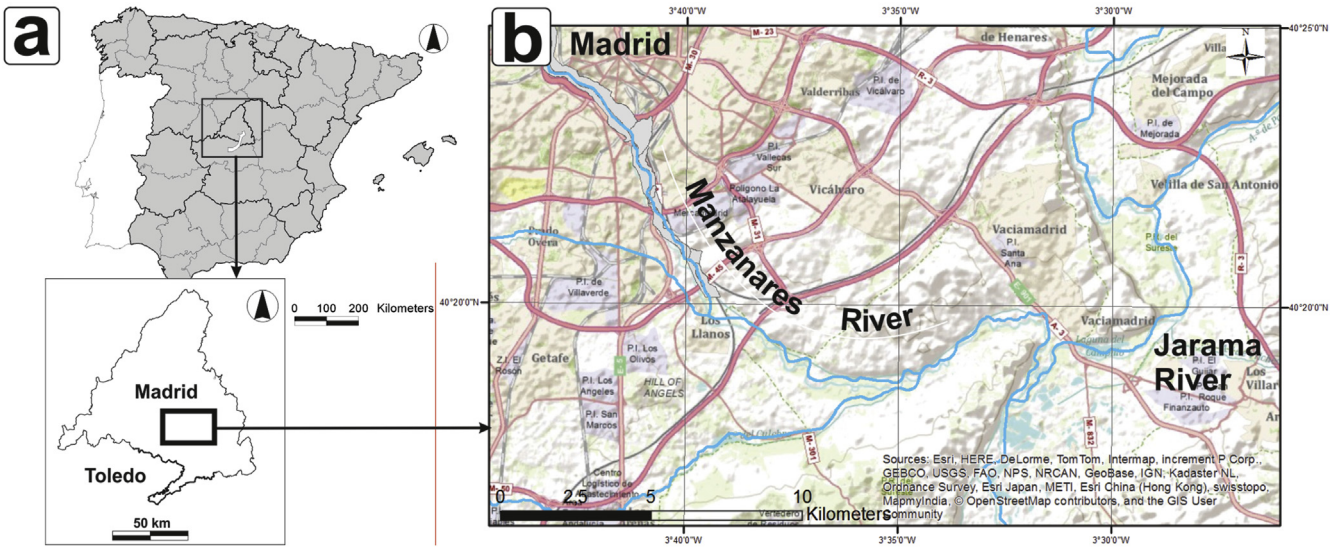

Fig. 3. Geographical framework of the Manzanares and Jarama valleys in Madrid (Spain).

Uribelarrea, 2008). These terraces constitute the so-called Terrace Complex of Butarque (Goy et al., 1989). From an archaeological point of view, such processes favour good preservation *in situ* of palaeontological and archaeological remains. The terraces involved in synsedimentary subsidence contain the youngest levels of the second half of the Middle Pleistocene, as well as those of the Late Pleistocene (Pérez-González et al., 2008; Yravedra et al., 2012; Rubio-Jara et al., 2016).

In the Jarama valley, 19 terrace levels have been recorded between +3 and 5 m and +190 m. The subsidence process in the river Jarama affects the terraces +30–32 m, +23–24 m and +18–20 m, as well as the current floodplain. All are included in one single terrace, the Complex Terrace of Arganda (CTA), which can reach up to 55 m in thickness. This terrace has been formed by the successive pilling up of alluvial deposits identified as Arganda I, II, III and IV, from base to top. The process of sinsedimentary subsidence has favoured the deposit of overbank facies along wide areas. Remarkable palaeontological and archaeological sites have been found on the overbank facies of Arganda I such as Áridos 1, Áridos 2, Valdocarros II at Arganda II, and also HAT in Arganda IV. These units have helped to establish a chronological timeframe obtained by Amino Acid Racemization (Pérez-González et al., 2008; Panera et al., 2011; Blain et al., 2012; Rubio-Jara et al., 2016), and by Electro Spin Resonance recently (Moreno et al., in press). Arganda I (~T+30–32 m) may correspond to the end of MIS 11 or early of MIS 9; Arganda II (~T+23–24 m) corresponds to between MIS 8 and MIS 7; Arganda III (~T+18–20 m) may fall close to the MIS 6; and finally the deposition of Arganda IV starts in MIS 5 and concludes in MIS 1 to the south of Arganda del Rey (Madrid).

2.4. Elephants and lithic tools in the Manzanares and Jarama valleys

Dozens of sites have been recorded throughout the Manzanares and Jarama valleys and their interfluves (Panera and Rubio-Jara, 2002), making the surrounds of Madrid city one of the areas with the highest density of Pleistocene sites in the Iberian Peninsula. Some sites, where only lithic tools have been recorded, have been interpreted as workshops or raw material source areas, such as Los Estragales, La Gavia or El Cañaveral (Gamazo et al., 1983; Baena et al., 2008; Pérez-González et al., 2008). Other sites show associations between faunal and lithic industry, such as Áridos 1, Arriaga, PRERESA, or Valdocarros (Santonja et al., 1980; Rus and Vega, 1984; Yravedra et al., 2010; Rubio-Jara et al., 2016). Other sites have evidence of human activity affecting one single species, as in Áridos 2 or PRERESA (Yravedra et al., 2010, 2012), or to many, as in Tafesa (Yravedra, 2010). Finally, there are a number of sites with faunal remains but which lack associated lithic industry. These are thought to be natural sites without human intervention, as the unpublished sites of Pegaso, Requeta Culebro or San Fernando, where rhinos, large bovines and equids have been recorded. A detailed analysis of each site would go beyond the limits of this paper, therefore we will focus solely on those sites with proboscidean remains.

Proboscideans are one of the best represented groups of mammals in the Lower and Middle Palaeolithic of the Madrid area, followed by horses and large bovids (Fig. 4). They constitute the third most abundant group in relation to the number of sites where they have been recorded (Fig. 4). The identified Pleistocene Proboscidean remains have been identified to the following species: *Mammuthus intermedius*, *Mammuthus trogontherii*, *Mammuthus primigenius* and *E. (Paleoloxodon) antiquus,* which is the best represented (Fig. 4).

However, despite the high representation of sites with remains of proboscideans in the Manzanares and Jarama valleys, no accumulation similar to those from Torralba or Ambrona has ever been found. The sites in the surroundings of Madrid have revealed low numbers of remains and represent one or a maximum of two individuals (Table 1). In many sites bones are easily misunderstood, whether because they are mere fragments, or complete or fractured tusks, such as the one from Estanque Tormentas de Butarque (Álvarez-Lao and García, 2011) (Fig. 5), or because the bone surfaces are poorly preserved, as at Arenero de Rojas (Panera et al., 2015). Furthermore, there are plenty of sites which do have remains, but the relationship between the fauna and the lithic industry is not clear. In other cases elephant remains and Acheulean tools are found together, although without a clear direct relationship, as is the case at Orcasitas and Transfesa.

In some instances, lack of archaeological context is due to a number of processes. Thus, there are sites which contain a mixture of materials coming from different levels and which have inconsistent chronologies. Such is the case at El Sotillo, Casa del Moreno, La Puñalada, El Arenero de Emilio Muñoz, El Arenero del Camino de San Martín or El Arenero de Vaciamadrid, where materials

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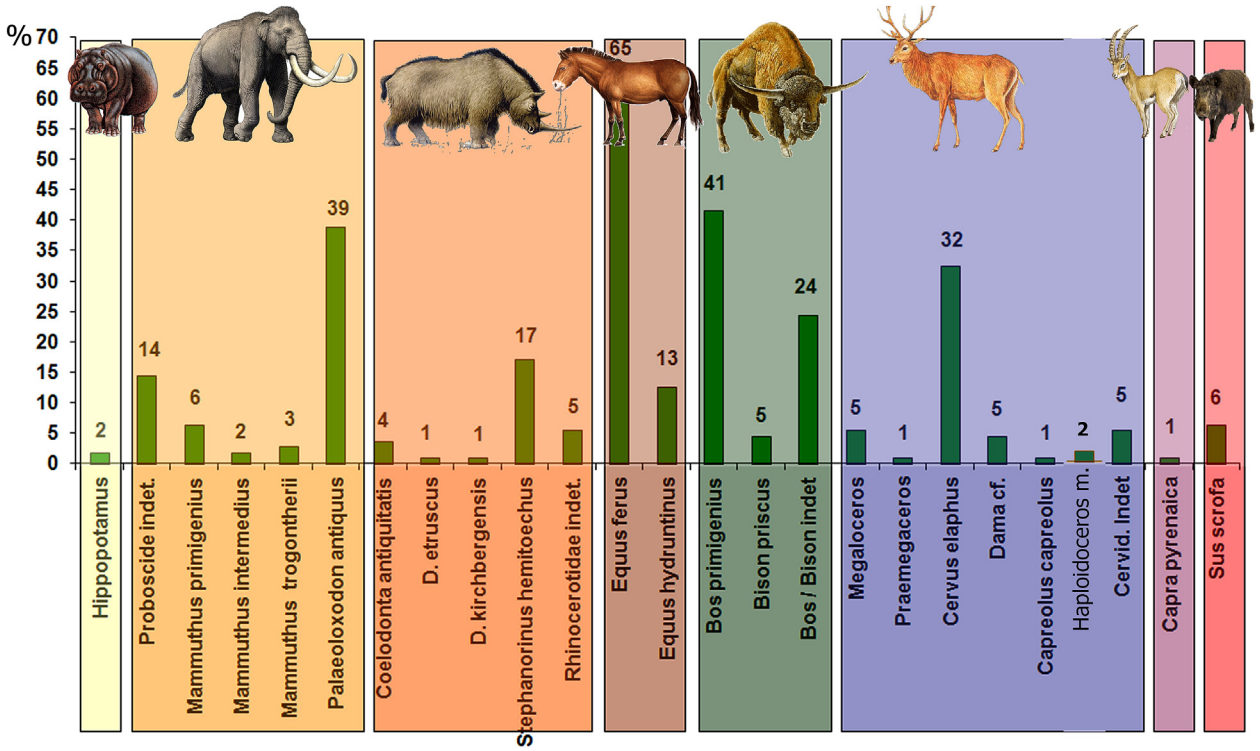

Fig. 4. Representative frequency of each taxon according to the number of sites where they have been recorded, e.g. *Equus ferus* has been identified in 65% of the sites of the studied area over a sample of 111 sites.

Fig. 5. Tusk (3.8 m) identified as of *E. (Paleoloxodon) antiquus* according to Ros Montoya 2010, in Estanque Tormentas de Butarque.

belonging to different Pleistocene periods have been found intermingled.

This mixture of materials has been the result of a deficient archaeological methodology – most were retrieved during excavations carried out between 1920 and 1970—as well as the different reclassifications carried out in the museum's collections. The urban growth which took place in Madrid during the second half of the 20th Century significantly affected the Pleistocene deposits of the Manzanares valley. Only a few initiatives, such as that carried out by the Instituto de Arqueología Municipal de Madrid between 1953 and 1977, directed by J. Martínez de Santaolalla (1905–1972), enabled the archaeological and palaeontological remains produced in the Manzanares fluvial sands quarries to be recorded (Quero-Crespo, 2002). These works enabled thousands of fossil remains

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and tens of thousands of lithic tools to be retrieved from quarry fluvial sands, such as at Oxígeno, Los Areneros de Viuda Martínez, El Mochuelo, Luis de Prado, Pegaso and Extremeños among others. Unfortunately, many of these samples have been preselected or lack stratigraphic references. It has been observed in several sites that although alterations such as abrasion, polishing or rounding are present on bones (Table 1), they are not always related to transport or fluvial re-deposition events. Thompson et al. (2011) have proved experimentally that bone remains can show many types of alterations even without having been subjected to water transportation. A relatively weak water current can transport abrasive substances that, when slid along the bone, gives rise to abrasion, polishing and rounding on the bones with no actual displacement.

Despite the issues already described for many of these sites (Rubio-Jara et al., 2002), several archaeological interventions, especially those carried out from 1975 onwards, do show proper stratigraphic sequences, as well as strict recording and digging methodologies. The interventions carried out in Áridos 1 and Áridos 2 (Santonja et al., 1980), Arriaga (Rus and Vega, 1984) and PRERESA (Panera et al., 2015), among others, allow a deeper understanding of the relationship between humans and proboscideans during Middle Pleistocene and the early Later Pleistocene.

4. Human intervention over Proboscideans during the Lower and Middle Palaeolithic.

It has been pointed out that there are Palaeolithic sites with proboscideans and lithic industries whose interpretation is problematic. The following section will focus on those sites where a clear relationship between lithic industry and fauna can be established, and where stratigraphic contexts have been clearly established.

During the Middle Pleistocene, at the sites described in our interest area, the remains of *E. (Paleoloxodon) antiquus* dominate the proboscideans. Only in Fábrica de Ladrillos and Arenero de Rojas remains of *Mammuthus intermedius* have been identified (Table 1).

With regard to the question of human intervention, a number of sites such as Tafesa (Yravedra, 2010), Valdocarros II (Panera et al., 2011; Rubio-Jara et al., 2016) and Estanque Tormentas de Butarque (Laplana et al., 2015), confirm evidence of human activity on the bones of different species, such as deers, horses or bovids (Table 1). However, evidence of processing of proboscideans has not been identified at these sites. The total elephant remains uncovered at Estanque de Tormentas de Butarque are restricted to a single tusk (Fig. 5).

By the late 1950's, the skull and tusks of an adult 45 year-old bull of *E. (Paleoloxodon) antiquus* were uncovered at the site of Orcasitas in the Complex Terrace of Butarque of the river Manzanares (Panera et al., 2015). Also, abundant remains of two further male adults of the same species, as well as some fractured long bones were uncovered at TRANSFESA (Meléndez and Aguirre, 1958). There is Acheulean industry from both these sites, although the information published is not enough to establish a relationship with the faunal remains. Evidence of anthropic action over proboscidean remains has been established in at least three Acheulean sites dated between MIS 13/11 and MIS 9: Tafesa, in the T +25–30 m of the Manzanares river, and Áridos 1 and Áridos 2, in the unit Arganda I of the Complex Terrace of Arganda in the Jarama valley.

Possible defleshing marks have been recorded on shafts of long bones and axial fragments of *E. (Paleoloxodon) antiquus* from the site of Tafesa (Yravedra, 2010), as well as a number of trampling marks on several ribs and other bones. The presence of cut marks on deer remains and large bovids from this same site proves that the hominins performed nutritional activities on the fauna of the site. This reinforces the thesis that the proboscideans were manipulated by the hominins, however marks have not been preserved due to the poor conservation of the cortical surface of the bone, of which a great deal show polishing and abrasion. Thus, some marks seem to be cuts rather than the result of trampling. These are shallow marks, with a wide section oriented obliquely opposite, flat bottomed and with no microstriations (Fig. 6).

In Áridos 1, part of the skeleton of an adult female *E. (Paleoloxodon) antiquus* was found scattered over an area of *c.* 50 m^2, uncovered in an overbank facies, together with 331 lithic pieces (flint and quartzite). These tools exhibited very sharp edges, including flakes originating from reshaping of at least two bifaces. The association and strict relationship between elephant remains and lithic pieces, distributed over practically the same area and with the presence of refits, seems beyond any doubt. The sedimentation process, which, judging by the condition of preservation of the bones, probably happened over a short time span, occurred under low energy conditions. This can rule out fluvial alterations in the archaeological assembly. Some pieces even show physical contact with the elephant remains, e.g. embedded in the skull, which was found in a state of fragmentation compatible with human activity (Santonja and Querol, 1980).

Only 200 m NE of Áridos 1, a new site, Áridos 2, with an equivalent stratigraphical position was found. Connected remains of an adult male *E. (Paleoloxodon) antiquus* were overlying an overbank facies, together with 34 lithic tools showing very sharp edges, over an area *c.* 12 m^2 (Santonja et al., 1980). The relationship

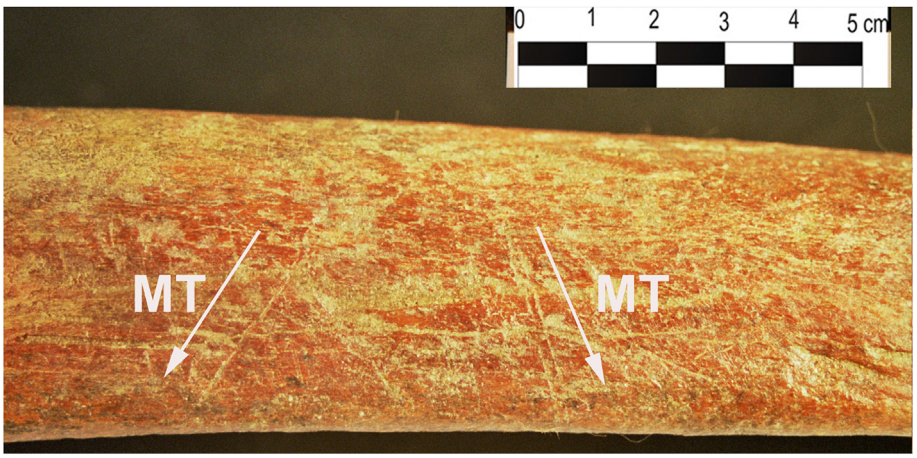

Fig. 6. Trampling marks (MT) on a *E. (Paleoloxodon) antiquus* rib from Tafesa.

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of the remains, which were covered by sand deposits, was at first questioned. Nonetheless recent research has established their association. Firstly, meat use wear polishing has been identified on the edges of several artifacts, suggesting that they were used to butcher elephants (Ollé, 2005). Secondly, several ribs and one scapula show evidence of alteration by humans, which could have been produced during the defleshing of a scapula (Yravedra et al., 2010-fig. 4-7-) and evisceration in the ventral side of the ribs (Yravedra et al., 2010-Fig. 9). This suggests that the hominins had early access to the elephant carcass. Carnivore marks causing an intense furrowing on the humerus distal epiphysis have also been observed (Yravedra et al., 2010-fig. 11-). Thus, both humans and carnivores have taken advantage of this proboscidean on different occasions, and although the precise cause of death of the elephant is unknown, the pattern of the evisceration marks suggests that the hominins took over the carcass before the carnivores.

In the fluvial Terrace Complex of Butarque in the Manzanares valley, the human exploitation of proboscideans during the Middle Palaeolithic has been established at several sites. The availability of luminescence-based numerical dates reveals that the visible extent of this deposit spans from MIS 6 to MIS 3 (Pérez-González et al., 2008; Silva et al., 2012; Panera et al., 2015; Rubio-Jara et al., 2016; Moreno et al., in press).

In Arriaga IIa, on an overbank facies, remains of an adult female *E. (Paleoloxodon) antiquus* were found clustered over 7/8 m^2, as well as 43 lithic pieces scattered over 35 m^2. Both assemblages were covered by fine sands. Elements bigger than 3 cm could not have been moved during the deposition process (Rus and Vega, 1984). Taphonomic analysis of the bone remains, stored in the Museo Arqueológico Nacional, which was carried out by one of the authors (J. Y.), has identified a possible cut mark (Fig. 7). Although the mark is V-shaped in section, it could be confused with a trampling mark. It is very small and isolated, and was identified on a rib recovered from a sandy soil, which could have favoured the presence of trampling. However, no other mark with such a deep V section has been observed on any other bones from this site. (Fig. 7).

EDAR Culebro 1 is another site close to Arriaga, with similar dates, 120,541+-6851 ka obtained by OSL. Only a small number of remains have been recovered from this site: remains of *Equus* sp., cervidae indet, together with 35 remains of *Mammuthus* cf *intermedius* according to E. Soto (in Manzano et al., 2011) versus the suggestion of Álvarez-Lao and García (2011), who identified the remains as *Mammuthus primigenius*. The remains of horse and deer do not show evidence of human activity, but the identification of a proboscidean humerus with a green fracture suggests the exploitation of bone marrow, according to Yravedra et al. (2014).

Exploitation of elephant marrow has also been recorded at PRERESA, a site close to EDAR Culebro 1 and Arriaga IIa. According to the last ESR dates published for PRERESA an early MIS 6 date is suggested (Moreno et al., in press). The site has provided 754 lithic pieces (Rubio-Jara, 2011), as well as an important assemblage of several mammals and 82 proboscidean bones, belonging to a single individual. These include carpals, tarsals, phalanges, fragments of tusk, metapodials, vertebrae, ribs, one complete scapula, one partial ulna and several fragments of long diaphysis and tibiae (Yravedra et al., 2012). Among the proboscidean remains, a number of fragments with percussion marks have been found (Yravedra et al., 2012-fig 4, 8-), as well as green fractures (Yravedra et al., 2012-fig. 4-5-6-7-) and cut marks (Yravedra et al., 2012-fig. 5-7-). This suggests that several activities linked to the exploitation of the meat and marrow of the animal were carried out.

With regard to other Late Pleistocene sites, *Mammuthus* predominate, of which the species *Mammuthus* cf. *primigenius* stands out, although traces of human activity have not been identified.

These pieces of evidence suggest that megafauna were a resource exploited on a recurrent basis by the Middle Pleistocene hominins, and that carnivores seem to have also had access to the proboscidean remains. Thus, in addition to the tooth marks on the *E. (Paleoloxodon) antiquus* humerus from Áridos 2, as well as a fracture produced by hyenas, there is the site of Arroyo Culebro, where hyena marks on rhino bones have also been observed (Fig. 8). Nevertheless, recent research carried out on Tafesa (Yravedra, 2010), Áridos (Yravedra et al., 2010), PRERESA (Yravedra et al., 2012, 2017b), Estanque de Tormentas (Yravedra et al., 2017a) and Valdocarros (Yravedra, 2007; in preparation) suggest that the competition between hominins and carnivores was not that substantial, as earlier access of the hominins to the resources has been recorded, whereas carnivores usually play a secondary role.

3. Discussion and conclusion

The presence of human activity has been attested since the first half of the Middle Pleistocene, but it is after MIS 11 when evidence becomes more numerous. The Acheulean, with the presence of bifaces shaped on large flakes, among other blanks, is well represented between MIS 11 and MIS 7, whereas the Middle Palaeolithic is identified at least between MIS 6 and MIS 3 (Panera et al., 2015; Rubio-Jara et al., 2016). Outcrops of flint and opal located on the plateau which defines the drainage divide between the two valleys have probably been exploited by humans throughout these periods.

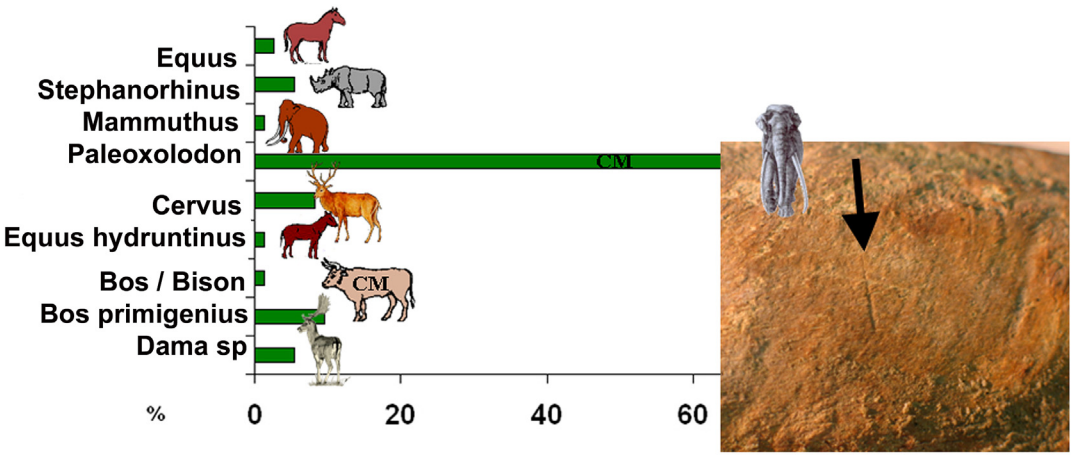

Fig. 7. Possible cut marks on a rib from Arriaga IIa and taxonomic profiles of the materials according to the NISP analysed in MAN (Museo Arqueológico Nacional). CM (Cut Marks).

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Fig. 8. Tooth marks on bones of rhinoceros of Arenero of Culebro.

Lithic industry associated with faunal remains has been found at several Pleistocene sites recorded in this area. Proboscideans are the third most representative group from the sites, after equids and bovids (Fig. 4). Although it is not easy to determine whether these remains were processed by human beings (Crader, 1983; Haynes and Krasinski, 2010), there is plenty of evidence in the Manzanares and Jarama valleys to suggest that these mega-herbivores were constantly exploited as a resource during the Lower and Middle Palaeolithic.

The existence of a high number of fluvial sand quarries dating to the Middle and Late Pleistocene which contain proboscidean remains and lithic industry has been connected to the geographic and environmental situation of the middle and lower courses of the Manzanares and Jarama rivers. They constitute an important ecological corridor with a Mediterranean climate – perfectly recorded during Middle Pleistocene and the beginning of Late Pleistocene – featuring several months of summer drought. The surrounding ecosystems were characterised by a sparse forest surface which favoured the gathering of herds of large mammals along the banks of the final stretch of the Manzanares River during the summer drought period (Panera et al., 2015).

Evidence of human proboscidean exploitation has been documented in Áridos 1, Áridos 2 (MIS 11-9), Arriaga IIa (MIS 6-5), PRERESA (beginning of MIS 6/end of MIS 5) and EDAR Culebro 1 (early MIS 5). *E. (Paleoloxodon) antiquus* has been identified at the first three sites –Áridos 1, Áridos 2 and Arriaga-, and *Mammuthus intermedius* at the last. The species could not be identified for PRERESA. The site of Tafesa could be added to this list, although the extent to which human involvement contributed to the presence of these elephant remains at the site cannot be confirmed until new analysis of the proboscidean remains is concluded. In addition, a cut mark identified on an ulna of *Stephanorhinus hemiotechus* in Arenero de Pedro Jaro reveals that other mega-mammals were also exploited, at least during the Middle Pleistocene. This evidence allows us to conclude that the proboscidean were exploited by the hominins, however a deeper insight into the hunting or non-hunting of these animal is not within reach. In Áridos 2, evisceration cut marks suggest early access to the elephant carcass, however, it cannot be assured whether the elephant was hunted or if it died of natural death, as this specimen is an over 30-year old adult (Santonja et al., 1980). In other sites only bones of adult individuals with cut marks have been recorded. In any case, it is remarkable that on occasions hominins and carnivores take advantage of the same elephant and that, as occurs in Áridos, it is the human beings who first intervene (Yravedra et al., 2010), or even the only ones to intervene as in PRERESA (Yravedra et al., 2012, 2017b) and EDAR Culebro 1.

Despite the fact that the evidence of proboscidean consumption does not explain how the hominins had access to these pachyderms, the presence of certain marks does allow an approximation. Thus, the evisceration marks identified on some ribs from Áridos 2 establish that, at least at this site, hominins gained access to the remains of the animal before carnivores, since even in carcasses this size carnivores eat the viscera first (Yravedra et al., 2010). The cut marks observed on some bones from Áridos 2 and PRERESA suggest activities linked to defleshing, and thanks to the percussion marks from PRERESA and the green fractures from PRERESA and EDAR Culebro 1, the marrow exploitation of these mammals has been established for the first time (Yravedra et al., 2012, 2014).

Bearing in mind that cut marks are rarely produced when defleshing or disarticulating elephants (Crader, 1983; Haynes and Krasinski, 2010), it should be taken into consideration that human intervention could also have been possible at other sites where evidence of consumption has not been identified. Poor preservation of bone surfaces is relatively frequent, as is the case at sites such as Arenero de Rojas, Tafesa, Arriaga, among others. Furthermore, before 1975 finds were not methodologically recorded. During collection, complete bones were given priority over fragments, which are precisely the ones to have more possibility of providing evidence of processing.

In the Manzanares and Jarama valleys, a substantial number of sites with Acheulean lithic industry associated with elephant remains (San Isidro, Transfesa, Áridos 1 and Áridos 2) have been recorded (Rubio-Jara et al., 2016), and in at least four Middle Palaeolithic sites (Arriaga IIa, EDAR Culebro 1, Arenero de Rojas and PRERESA) evidence suggests that mega-mammals also were exploited by humans (Yravedra et al., 2014; Panera et al., 2015). This implies that Mousterian groups displayed and used these animal resources in a similar way to the Acheulean groups, and therefore, that there were no important changes to the subsistence strategies linked to these mammals among the hominins responsible for these two technocomplexes.

Exploitation of mega-mammals during the Acheulean and Mousterian has also been verified in Europe (Table 2). Regardless of the technocomplex, timeframe or site type (whether open areas, caves or rock shelters), human groups processed proboscidean and rhinos during the Pleistocenes. There are however significantly more sites with remains of mega-mammals showing man-made marks in open areas than in caves or rock shelters, most likely because that would be the natural ecological habitat of those mammals.

Among all sites with evidence of processing of mega-mammals, whether from the European Acheulean or Mousterian (Table 2) and including the Manzanares and Jarama area, hunting strategies have been observed solely in Cotte de St. Brelade according to Scott (1986); however, the interpretation of this site has been discussed by Scott et al. (2014) and Smith (2015), who have provided an alternative to the traditional explanation of the site. In other sites, only cut and percussion marks have been identified, as well as evidence of breakage, which suggest that the remains were exploited for nutritional purposes, but whether the animals were hunted or scavenged cannot be specified. Further research should allow advances in this direction, as has already been achieved in Upper Palaeolithic contexts, where the impact of projectile points have been documented on mammoth bones (Surovell and Waguespack, 2008; Walters et al., 2011; Haynes, 2015).

In any case, and regardless of the way in which the proboscidean carcasses were obtained, there are other aspects possible to research. Proboscideans are the best represented species from the

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Table 2
Main European Lower and middle Palaeolithic sites with evidence of megafauna handled by human beings.

Site	Chronology	Lithic Complex	Type of site	Megafaunal	MNI	Anthropogenic Alterations	References
Covalejos	Upper Pleistocene (MIS 5)	Acheulean	Rock Shelter	Rhino.		Cut Marks	Yravedra et al., 2016
Abric Romaní	Upper Pleistocene (MIS 4)	Mousterian	Rock Shelter	Rhino.		Cut Marks	Rosell et al., 2012
Bolomor	Middle Pleistocene	Lower Palaeolithic	Rock Shelter	Proboscidian-Hipopoótamo	Several	Cut Marks	Blasco and Fernández-Peris, 2012
Ambrona	Middle Pleistocene	Acheulean	Open	Proboscidian	Several	Cut Marks	Villa et al., 2005
Preresa	Upper Pleistocene (MIS 5)	Muteriense	Open	Proboscidian	1	Cut Marks, Percussion Marks, Green Fracture	Yravedra et al., 2012
Edar Culebro	Upper Pleistocene (MIS 5)	Muteriense	Open	Proboscidian	1	Green Fracture	Yravedra et al., 2014
Áridos 2	Middle Pleistocene	Acheulean	Open	Proboscidian	1	Cut Marks	Yravedra et al., 2010
Arriaga	Upper Pleistocene (MIS 5)	Middle Palaeolithic	Open	Proboscidian	Several	Cut Marks?	Panera et al., 2015
Tafesa	Middle Pleistocene	Acheulean	Open	Proboscidian	Several	Cut Marks?	Yravedra, 2010
Arenero Pedro Jaro	Upper Pleistocene (MIS 4)	Mousterian	Open	Rhino.	1	Cut Marks	Inédito
Lehringen	Middle Pleistocene	Acheulean	Open	Proboscidian	1	Cut Marks	Thieme and Veil, 1985
Gröbern	Middle Pleistocene	Acheulean	Open	Proboscidian	1	Use Wear in Lithic	Weber, 2000
Bilzigsleben	Middle Pleistocene	Acheulean	Open	Proboscidian	1	Cut Marks	Mania, 1995
Bechatow	Middle Pleistocene	Acheulean	Open	Proboscidian	1	Cut Marks	Pawlowska et al., 2015
Castel di Guido	Middle Pleistocene	Acheulean	Open	Proboscidian	Several	Cut Marks	Boschian and Sacca, 2010, 2015
Isernia la Pineta	Middle Pleistocene	Acheulean	Open	Proboscidian	Several	Green Fracture	Musi, 2005
Nortachirico	Middle Pleistocene	Acheulean	Open	Proboscidian	Several	Cut Marks?	Musi, 2005
Asolo	Upper Pleistocene	Mousterian	Cave	Proboscidian	1	Green Fracture	Musi and Villa, 2008
Revadin Quarri	Middle Pleistocene	Acheulean	Open	Proboscidian	1	Green Fracture and Use Wear in Lithic	Rabinovich et al., 2012; Solodenko et al., 2015
Gaser Ben Y'Akov	Middle Pleistocene	Acheulean	Open	Proboscidian	1	Cut Marks and Use Wear in Lithic	Goren Imbar et al., 2014
Southfleet road, Ebbsfleet	Middle Pleistocene	Lower Palaeolithic	Open	Proboscidian	1	Cut Marks	Wenban-Smith et al., 2006
Boxgrove	Middle Pleistocene	Acheulean	Open	Rhino.	Several	Cut Marks	Smith, 2012
Cotte de St. Brelade	Middle Pleistocene	Lower and Middle Palaeolithic	Open	Proboscidian y Rhino.	Several	Cut Marks	Scott, 1986
Molodova	Upper Pleistocene	Mousterian	Open	Proboscidian	Several	Cut Marks	Demay et al., 2012
Krapina	Pleistoceno superior	Mousterian	Cave	Rhino.	Several	Cut Marks	Patou-Mathis, 1997
Zwolen	Upper Pleistocene	Mousterian	Open	Rhino.	Several	Cut Marks	Schild et al., 2000
Mutzig	Upper Pleistocene	Mousterian	Open	Proboscidian	1	Cut Marks	Patou-Mathis, 1999
Spy	Upper Pleistocene	Mousterian	Cave	Proboscidian	Several	Use Wear in Lithic isotopes	Germompré et al., 2014
Payre	Upper Pleistocene	Mousterian	Shelter	Proboscidian and Rhino.	Several	Cut Marks	Daujeard, 2008
Montdol	Upper Pleistocene	Mousterian	Open	Proboscidian and Rhino.	Several	Cut Marks	Louguet-Lefebvre, 2005
Taubach	Upper Pleistocene	Mousterian	Open	Rhino.	Several	Cut Marks	Bratlund, 1999
Terra Amata	Upper Pleistocene	Mousterian	Shelter	Proboscidian	Several	Cut Marks	Valensi, 1996
Lazaret	Upper Pleistocene	Mousterian	Cave	Proboscidian	Several	Acumulación especializada	Valensi, 2001
Scladina	Upper Pleistocene	Mousterian	Cave	Rhino.	Several	Cut Marks	Patou-Mathis, 1998
Tournal	Upper Pleistocene	Mousterian	Cave	Proboscidian	Several	Cut Marks	Magniez, 2010
Biache Saint Vast	Upper Pleistocene	Mousterian	Cave	Rhino.	Several	Cut Marks	Auguste, 1995
Saint Cesaire	Upper Pleistocene	Mousterian	Cave	Rhino.	Several	Cut Marks	Morin et al., 2016

sites of the Manzanares and Jarama rivers, followed by bovides and equides. This could be due to the sites location on fluvial basins and within open environments, and also because larger size remains would be easier to identify than those of other species. Such high representation contrasts with that of proboscidean and rhinos in caves and shelters of the Middle and Lower Palaeolithic of the Iberian Peninsula, where they are seldom recorded, as in Bolomor (Blasco and Fernández-Peris, 2012), Abric Romaní (Rosell et al., 2012), and Covalejos (Yravedra et al., 2016). Both in the Cantábrico as in the Mediterranean areas these fauna are scarcely recorded, probably because Pleistocene deposits are poorly preserved in these valleys.

Animals other than proboscidean were exploited in the Manzanares and Jarama valleys during the Acheulean and Middle Palaeolithic, such as horses, deer and bovides. At Tafesa, a site belonging to the Middle Pleistocene and with distinctly Acheulean technocomplexes, the remains of deer and large bovids with cut marks have been observed. These marks hint at defleshing and a disarticulation processes and suggest early access to animal resources (Yravedra, 2010). The preliminary data from the taphonomic study of Valdocarros also points to similar evidence regarding cervides, equides and large bovides (Yravedra, under preparation). Evidence of defleshing and disarticulation on a fox tibia have been identified (Yravedra, 2007).

With regard to the Late Middle Pleistocene Late Pleistocene and with Middle Palaeolithic technology, marks have been observed on several sites: in Estanque de Tormentas de Butarque, marks on bone remains of cervides, equides and large bovides suggest early access to meat (Yravedra et al., 2017a); cut marks on bones of large bovides in Arriaga (Fig. 7), on middle-sized (100–400 kg) and large (400–1000 kg) ungulate bones in PRERESA (Yravedra et al., 2017b). In the sand quarries of Santa Catalina (MIS 3–4) and Viuda Martínez (MIS 5), cut marks have been recorded on equid remains; in the sand quarries of Santa Elena (MIS 6) and la Aldehuela, cut marks on auroch were uncovered. Unfortunately, the assemblages of faunal remains of these sites are scarce and biased, as the excavation of

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these sites took place prior to 1970.

In conclusion, in the terraces of the Manzanares and Jarama rivers numerous faunal remains have been recorded. Cervides, equides, bovides, rhinos and proboscidean were exploited by human groups using Acheulean and Mousterian technologies. Although there are not enough studies to allow the characterization of how small and medium-sized ungulates were exploited, at least a broad record of the megafauna is available for the analysis of the exploitation of these animals in both periods.

Thanks to the available data, it has been recorded that proboscidean were exploited by humans during the Middle and Late Pleistocene, although aspects of how these animals were acquired remain inconclusive. It is likely that the proboscidean exploited in the Manzanares and Jarama were obtained through opportunistic strategies in Áridos, Arriaga, PRERESA, EDAR Culebro 1, and even in Tafesa, where all individuals are adults. All these sites are located in fluvial environments, which are areas of natural death for these mammals (Haynes, 1991). Additionally, the remains of all the anatomic parts of elephants have been recorded, including cranial bones, axial and appendicular remains, which suggest that complete skeletons were likely to be present. Pathologies of fractures due to projectile points have not been recorded. This set of evidence would suggest natural death of the individuals and subsequent exploitation by the human beings. However, as revealed by the evisceration marks from Áridos 2, human intervention would occur at an early stage, revealing primary access to the carcases for those individuals, prior to other predators such as hyenas. Furthermore, percussion and fracture marks observed in PRERESA and EDAR Culebro 1 suggest an intense exploitation of the proboscidean, irrespective of their large size.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.quaint.2017.12.002.

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